AMENDMENTS TO THE CLAIMS

In the Claims:

1. (Currently Amended) A method of enhancing cardiac pacing, the method comprising:

measuring at least one characteristic of a heart using one or more parameter measuring devices disposed in the heart;

calculating at least one cardiac performance parameter using the at least one measured characteristic; ~~and~~

accepting at least one command from a user, said command assigning a relative weight to said at least one cardiac performance parameter, and

automatically adjusting at least one functional parameter of a cardiac pacing device**, wherein said adjusting comprises determining said adjustment to be made to the at least one functional parameter based on the at least one cardiac performance parameter and said assigned relative weight of said at least one cardiac performance parameter**.

2. (Original) A method as in claim 1, wherein the at least one functional parameter is automatically adjusted based on the at least one calculated cardiac performance parameter.

3. (Original) A method as in claim 1, wherein measuring the at least one characteristic comprises measuring with at least one sensor device implanted in at least one wall of the heart.

4. (Original) A method as in claim 1, wherein measuring the at least one characteristic comprises measuring with at least one catheter device disposed in at least one chamber of the heart.

5. (Original) A method as in claim 4, wherein measuring the at least one characteristic further comprises measuring with at least one sensor device implanted in at least one wall of the heart.

6. (Original) A method as in claim 4, wherein the at least one catheter comprises a catheter positioned only in the right side of the heart.

7. (Original) A method as in claim 4, wherein the at least one catheter comprises a multiplexed catheter.

8. (Original) A method as in claim 7, wherein the at least one multiplexed catheter is disposed at least partially within at least one of a left ventricle and a right ventricle of the heart.

9. (Original) A method as in claim 1, wherein measuring the at least one characteristic comprises measuring at least one of pressure, volume, blood flow velocity, blood oxygen concentration, carbon dioxide concentration, wall stress, wall thickness, force, electric charge, electric current and electric conductivity.

10. (Original) A method as in claim 9, wherein each characteristic is measured in at least one of a chamber of the heart, a wall of the heart and a blood vessel adjacent the heart.

11. (Original) A method as in claim 9, wherein measuring comprises:

measuring at least one blood oxygen concentration in at least one chamber on the left side of the heart; and

measuring at least one blood oxygen concentration in at least one chamber on the right side of the heart.

12. (Original) A method as in claim 11, further comprising:

measuring a systemic vascular resistance; and

automatically adjusting the cardiac pacing device based on at least one of the measured blood oxygen concentrations and on the measured systemic vascular resistance.

13. (Original) A method as in claim 1, wherein measuring the at least one characteristic comprises measuring at least one blood oxygen concentration in a patient having a shunt.

14. (Original) A method as in claim 13, further comprising positioning at least a portion of a parameter measuring device in at least one of a pulmonary artery, a superior vena cava, an inferior vena cava and a right ventricle, wherein the portion of the parameter measuring device includes means for measuring blood oxygen content.

15. (Original) A method as in claim 14, wherein automatically adjusting comprises adjusting the cardiac pacing device based on at least one blood oxygen content measured by the parameter measuring device.

16. (Original) A method as in claim 1, wherein calculating the at least one cardiac performance parameter comprises calculating at least one of ejection fraction, cardiac output, cardiac index, stroke volume, stroke volume index, pressure reserve, volume reserve, cardiac reserve, cardiac reserve index, stroke reserve index, myocardial work, myocardial work index, myocardial reserve, myocardial reserve index, stroke work, stroke work index, stroke work reserve, stroke work reserve index, systolic ejection period, stroke power, stroke power reserve, stroke power reserve index, myocardial power, myocardial power index, myocardial power reserve, myocardial power reserve index, myocardial power requirement, dP/dt, d^2P/dt, ejection contractility, cardiac efficiency, cardiac amplification, valvular gradient, valvular gradient reserve, valvular area, valvular area reserve, valvular regurgitation, valvular regurgitation reserve, a pattern of electrical emission by the heart, concentration of oxygen in the cardiac vein, and a ratio of carbon dioxide to oxygen.

17. (Original) A method as in claim 1, wherein the cardiac pacing device comprises one or more pacing leads.

18. (Original) A method as in claim 17, wherein at least one of the pacing leads comprises two or more electrodes disposed along its length.

19. (Original) A method as in claim 18, wherein the two or more electrodes are multiplexed with the at least one pacing lead.

20. (Original) A method as in claim 1, wherein adjusting the at least one functional parameter comprises adjusting at least one of a selected electrode of the cardiac pacing device to be activated, a pulse width of an activation of the cardiac pacing device, a pulse amplitude, a pulse duration, a number of pulses per one cycle of the heart, a pulse polarity, a pulse duty cycle, a timing of pulses relative to a cycle of the heart and a timing of pulses from multiple electrodes of the pacing device relative to one another.

21. (Currently Amended) A method as in claim 1, wherein **~~adjusting the at least one functional parameter~~** **said method further** comprises:

assigning a first relative weight to a first calculated cardiac performance parameter;

assigning a second relative weight to a second calculated cardiac performance parameter; and

determining **said** at least one adjustment to be made to the at least one functional parameter, based on the first and second calculated cardiac performance parameters and the first and second relative weights.

22. (Original) A method as in claim 21, further comprising:

assigning a third relative weight to a third calculated cardiac performance parameter; and

determining the at least one adjustment, based on the first, second and third calculated cardiac performance parameters and the first, second and third relative weights.

23. (Currently Amended) A method as in claim 21, further comprising:

determining at least one apparatus performance parameter of the cardiac pacing ~~apparatus~~ **device**;

assigning a third relative weight to the apparatus performance parameter; and

determining the at least one adjustment, based on the first and second calculated cardiac performance parameters, the at least one apparatus performance parameter and the first, second and third relative weights.

24. (Currently Amended) A method as in claim 23, wherein determining the at least one apparatus performance parameter comprises determining at least one of an energy consumption rate, a maximum current and a maximum voltage of the cardiac pacing ~~apparatus~~ **device**.

25. (Cancelled)

26. (Currently Amended) A method as in claim **1** ~~25~~, further comprising accepting an additional command from the user, the additional command assigning a relative weight to at least one apparatus performance parameter, wherein adjusting the at least one functional parameter comprises determining the adjustment based on the at least one cardiac performance parameter, the at least one apparatus performance parameter and the assigned relative weights of each.

27. (Original) A method as in claim 1, further comprising providing at least one calculated cardiac performance parameter to a user in the form of data.

28. (Original) A method as in claim 27, wherein the data is provided as one or more images on a display monitor.

29. (Original) A method as in claim 27, further comprising accepting at least one command from the user, the command designating one or more of the calculated cardiac performance parameters to be provided to the user.

30. (Original) A method as in claim 27, further comprising:

measuring the at least one characteristic of the heart after the adjustment step;

calculating the at least one cardiac performance parameter using the at least one re-measured characteristic; and

automatically adjusting at least one functional parameter of a cardiac pacing device.

31. (Original) A method as in claim 30, wherein the measuring, calculating and adjusting steps are performed multiple times, and wherein the calculated cardiac performance parameter is provided to the user in the form of data for each adjustment of the functional parameter of the pacing device.

32. (Original) A method as in claim 31, wherein the data is provided to the user in the form of a three-dimensional graph on a display monitor.

33. (Original) A method as in claim 1, wherein automatically adjusting comprises setting the cardiac pacing device to fire with a timing such that it does not fire during each heart cycle.

34. (Original) A method as in claim 33, wherein the timing is selected from the group consisting of firing once every two cycles, once every three cycles and once every four cycles.

35. (Original) A method as in claim 33, wherein setting the cardiac pacing device further comprises selecting at least one firing pattern from a group of possible firing patterns.

36. (Original) A method as in claim 1, wherein automatically adjusting comprises causing the cardiac pacing device to stimulate at least a first chamber of the heart before stimulating at least a second chamber of the heart.

37. (Original) A method as in claim 36, wherein the cardiac pacing device stimulates the right atrium before stimulating the right ventricle.

38. (Original) A method as in claim 36, wherein the cardiac pacing device stimulates both atria before stimulating both ventricles.

39. (Original) A method as in claim 36, wherein the cardiac pacing device stimulates the right ventricle before stimulating the left ventricle.

40. (Original) A method as in claim 36, wherein the cardiac pacing device stimulates the right ventricle before stimulating the right atrium.

41. (Original) A method as in claim 36, wherein the cardiac pacing device stimulates the left ventricle before stimulating the right ventricle or the right atrium.

42. (Original) A method as in claim 36, wherein automatically adjusting further comprises:

comparing at least one left ventricular end diastolic pressure measured by the parameter measuring device with a pre-defined left ventricular end diastolic pressure control range; and

adjusting the cardiac pacing device based on the comparison.

43. (Original) A method as in claim 42, further comprising:

measuring at least one right ventricular pressure; and

adjusting the cardiac pacing device based on the comparison and on the measured right ventricular pressure.

44. (Original) A method as in claim 1, wherein automatically adjusting comprises causing the cardiac pacing device to stimulate at least a first valve of the heart before stimulating at least a second valve of the heart.

45. (Original) A method as in claim 1, wherein measuring comprises:

measuring at least a first pressure using a first lead positioned in at least one of the right atrium and the right ventricle of the heart; and

measuring at least a second pressure using a second lead positioned in the coronary vein over the left ventricle of the heart.

46. (Original) A method as in claim 45, further comprising measuring an ambient pressure.

47. (Original) A method as in claim 45, wherein calculating comprises estimating a left ventricular pressure from the second pressure.

48. (Original) A method as in claim 45, wherein adjusting comprises adjusting timing of firing of the first and second leads.

49. (Original) A method as in claim 48, wherein adjusting the firing timing comprises adjusting the timing to minimize left ventricular end diastolic pressure.

50. (Original) A method as in claim 48, wherein adjusting the firing timing comprises adjusting the timing to minimize left ventricular end diastolic pressure in response to at least one measured parameter measured by at least one sensor.

51. (Original) A method as in claim 48, wherein adjusting the firing timing comprises adjusting the timing to increase left ventricular end diastolic pressure to increase cardiac output.

52. (Original) A method as in claim 48, wherein adjusting the firing timing comprises adjusting the timing to increase cardiac output in response to at least one measured parameter measured by at least one sensor.

53. (Currently Amended) A method of enhancing cardiac pacing **as in claim 1**, the method comprising:

measuring at least a first pressure using a first sensor positioned in at least one of the right atrium and the right ventricle of a heart;

measuring at least a second pressure using a second sensor positioned in the coronary vein over the left ventricle of the heart;

measuring an ambient pressure for use in calculating a gauge pressure; and

adjusting the cardiac pacing based on the measured first and second gauge pressures.

54. (Currently Amended) A method of enhancing cardiac pacing **as in claim 1**, the method comprising:

measuring at least one left ventricular end diastolic pressure;

measuring a proxy for ambient pressure for use in calculating a gauge pressure; and

adjusting the cardiac pacing based on the gauge pressure.

55. – 100 (Cancelled)

101. (New) A method of enhancing cardiac pacing, the method comprising:

measuring at least one characteristic of a heart using one or more parameter measuring devices disposed in the heart;

calculating at least one cardiac performance parameter using the at least one measured characteristic; and

automatically adjusting at least one functional parameter of a cardiac pacing device, wherein said adjusting comprises:

assigning a first relative weight to a first calculated cardiac performance parameter;

assigning a second relative weight to a second calculated cardiac performance parameter;

determining at least one apparatus performance parameter of the cardiac pacing device;

assigning a third relative weight to said apparatus performance parameter; and

determining at least one adjustment to be made to the at least one functional parameter, based on the first and second calculated cardiac performance parameters,

the at least one apparatus performance parameter and the first, second and third relative weights.

102. (New) A method as in claim 101, wherein measuring the at least one characteristic comprises measuring with at least one sensor device implanted in at least one wall of the heart.

103. (New) A method as in claim 101, wherein measuring the at least one characteristic comprises measuring with at least one catheter device disposed in at least one chamber of the heart.

104. (New) A method as in claim 103, wherein measuring the at least one characteristic further comprises measuring with at least one sensor device implanted in at least one wall of the heart.

105. (New) A method as in claim 103, wherein the at least one catheter comprises a catheter positioned only in the right side of the heart.

106. (New) A method as in claim 103, wherein the at least one catheter comprises a multiplexed catheter.

107. (New) A method as in claim 106, wherein the at least one multiplexed catheter is disposed at least partially within at least one of a left ventricle and a right ventricle of the heart.

108. (New) A method as in claim 101, wherein measuring the at least one characteristic comprises measuring at least one of pressure, volume, blood flow velocity, blood oxygen concentration, carbon dioxide concentration, wall stress, wall thickness, force, electric charge, electric current and electric conductivity.

109. (New) A method as in claim 108, wherein each characteristic is measured in at least one of a chamber of the heart, a wall of the heart and a blood vessel adjacent the heart.

110. (New) A method as in claim 108, wherein measuring comprises:

measuring at least one blood oxygen concentration in at least one chamber on the left side of the heart; and

measuring at least one blood oxygen concentration in at least one chamber on the right side of the heart.

111. (New) A method as in claim 110, further comprising:

measuring a systemic vascular resistance; and

automatically adjusting the cardiac pacing device based on at least one of the measured blood oxygen concentrations and on the measured systemic vascular resistance.

112. (New) A method as in claim 101, wherein measuring the at least one characteristic comprises measuring at least one blood oxygen concentration in a patient having a shunt.

113. (New) A method as in claim 112, further comprising positioning at least a portion of a parameter measuring device in at least one of a pulmonary artery, a superior vena cava, an inferior vena cava and a right ventricle, wherein the portion of the parameter measuring device includes means for measuring blood oxygen content.

114. (New) A method as in claim113, wherein automatically adjusting comprises adjusting the cardiac pacing device based on at least one blood oxygen content measured by the parameter measuring device.

115. (New) A method as in claim 101, wherein calculating the at least one cardiac performance parameter comprises calculating at least one of ejection fraction, cardiac output, cardiac index, stroke volume, stroke volume index, pressure reserve, volume reserve, cardiac reserve, cardiac reserve index, stroke reserve index, myocardial work, myocardial work index, myocardial reserve, myocardial reserve index, stroke work, stroke work index, stroke work reserve, stroke work reserve index, systolic ejection period, stroke power, stroke power reserve, stroke power reserve index,

myocardial power, myocardial power index, myocardial power reserve, myocardial power reserve index, myocardial power requirement, dP/dt, d^2P/dt, ejection contractility, cardiac efficiency, cardiac amplification, valvular gradient, valvular gradient reserve, valvular area, valvular area reserve, valvular regurgitation, valvular regurgitation reserve, a pattern of electrical emission by the heart, concentration of oxygen in the cardiac vein, and a ratio of carbon dioxide to oxygen.

116. (New) A method as in claim 101, wherein the cardiac pacing device comprises one or more pacing leads.

117. (New) A method as in claim 116, wherein at least one of the pacing leads comprises two or more electrodes disposed along its length.

118. (New) A method as in claim 117, wherein the two or more electrodes are multiplexed with the at least one pacing lead.

119. (New) A method as in claim 101, wherein adjusting the at least one functional parameter comprises adjusting at least one of a selected electrode of the cardiac pacing device to be activated, a pulse width of an activation of the cardiac pacing device, a pulse amplitude, a pulse duration, a number of pulses per one cycle of the heart, a pulse polarity, a pulse duty cycle, a timing of pulses relative to a cycle of the heart and a timing of pulses from multiple electrodes of the pacing device relative to one another.

120. (New) A method as in claim 101, wherein said determining the at least one apparatus performance parameter comprises determining at least one of an energy consumption rate, a maximum current and a maximum voltage of the cardiac pacing apparatus.

121. (New) A method as in claim 101, further comprising:

assigning a fourth relative weight to a third calculated cardiac performance parameter; and

determining the at least one adjustment, based on the first, second and third calculated cardiac performance parameters, the apparatus performance parameter, and the first, second, third and fourth relative weights.

122. (New) A method as in claim 101, further comprising providing at least one calculated cardiac performance parameter to a user in the form of data.

123. (New) A method as in claim 122, wherein the data is provided as one or more images on a display monitor.

124. (New) A method as in claim 122, further comprising accepting at least one command from the user, the command designating one or more of the calculated cardiac performance parameters to be provided to the user.

125. (New) A method as in claim 122, further comprising:

measuring the at least one characteristic of the heart after the adjustment step;

calculating the at least one cardiac performance parameter using the at least one re-measured characteristic; and

automatically adjusting at least one functional parameter of a cardiac pacing device.

126. (New) A method as in claim 125, wherein the measuring, calculating and adjusting steps are performed multiple times, and wherein the calculated cardiac performance parameter is provided to the user in the form of data for each adjustment of the functional parameter of the pacing device.

127. (New) A method as in claim 126, wherein the data is provided to the user in the form of a three-dimensional graph on a display monitor.

128. (New) A method as in claim 101, wherein automatically adjusting comprises setting the cardiac pacing device to fire with a timing such that it does not fire during each heart cycle.

129. (New) A method as in claim 128, wherein the timing is selected from the group consisting of firing once every two cycles, once every three cycles and once every four cycles.

130. (New) A method as in claim 128, wherein setting the cardiac pacing device further comprises selecting at least one firing pattern from a group of possible firing patterns.

131. (New) A method as in claim 101, wherein automatically adjusting comprises causing the cardiac pacing device to stimulate at least a first chamber of the heart before stimulating at least a second chamber of the heart.

132. (New) A method as in claim 131, wherein the cardiac pacing device stimulates the right atrium before stimulating the right ventricle.

133. (New) A method as in claim 131, wherein the cardiac pacing device stimulates both atria before stimulating both ventricles.

134. (New) A method as in claim 131, wherein the cardiac pacing device stimulates the right ventricle before stimulating the left ventricle.

135. (New) A method as in claim 131, wherein the cardiac pacing device stimulates the right ventricle before stimulating the right atrium.

136. (New) A method as in claim 131, wherein the cardiac pacing device stimulates the left ventricle before stimulating the right ventricle or the right atrium.

137. (New) A method as in claim 131, wherein automatically adjusting further comprises:

comparing at least one left ventricular end diastolic pressure measured by the parameter measuring device with a pre-defined left ventricular end diastolic pressure control range; and

adjusting the cardiac pacing device based on the comparison.

138. (New) A method as in claim 137, further comprising:

measuring at least one right ventricular pressure; and

adjusting the cardiac pacing device based on the comparison and on the measured right ventricular pressure.

139. (New) A method as in claim 101, wherein automatically adjusting comprises causing the cardiac pacing device to stimulate at least a first valve of the heart before stimulating at least a second valve of the heart.

140. (New) A method as in claim 101, wherein measuring comprises:

measuring at least a first pressure using a first lead positioned in at least one of the right atrium and the right ventricle of the heart; and

measuring at least a second pressure using a second lead positioned in the coronary vein over the left ventricle of the heart.

141. (New) A method as in claim 140, further comprising measuring an ambient pressure.

142. (New) A method as in claim 140, wherein calculating comprises estimating a left ventricular pressure from the second pressure.

143. (New) A method as in claim 140, wherein adjusting comprises adjusting timing of firing of the first and second leads.

144. (New) A method as in claim 143, wherein adjusting the firing timing comprises adjusting the timing to minimize left ventricular end diastolic pressure.

145. (New) A method as in claim 143, wherein adjusting the firing timing comprises adjusting the timing to minimize left ventricular end diastolic pressure in response to at least one measured parameter measured by at least one sensor.

146. (New) A method as in claim 143, wherein adjusting the firing timing comprises adjusting the timing to increase left ventricular end diastolic pressure to increase cardiac output.